(No Model.)

3 Sheets—Sheet 1.

C. BERNHARDT.

ELECTRIC FIRE ALARM.

No. 501,905. Patented July 18, 1893.

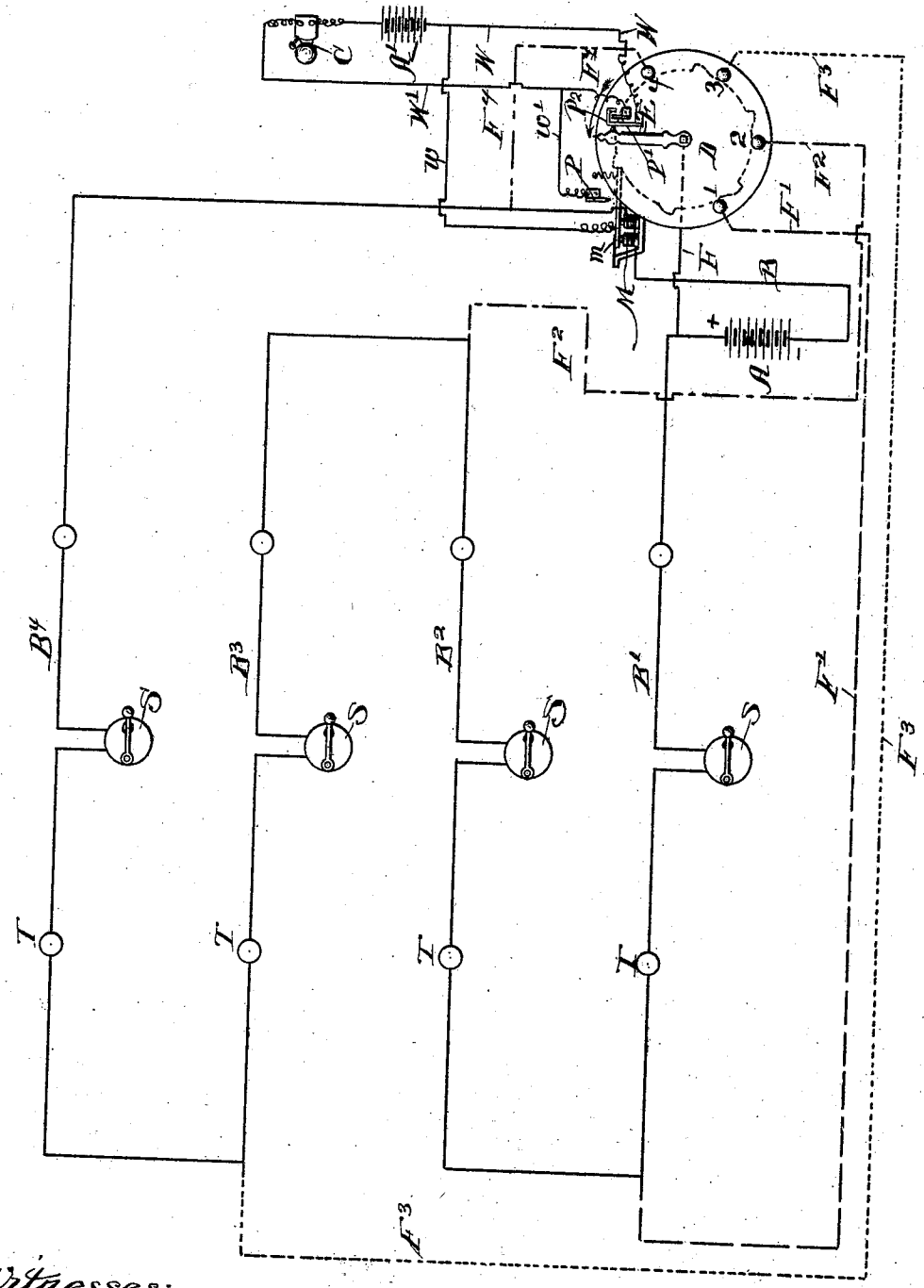

Fig. 1.

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No Model.)

3 Sheets—Sheet 2.

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ELECTRIC FIRE ALARM.

No. 501,905. Patented July 18, 1893.

Fig. 3.

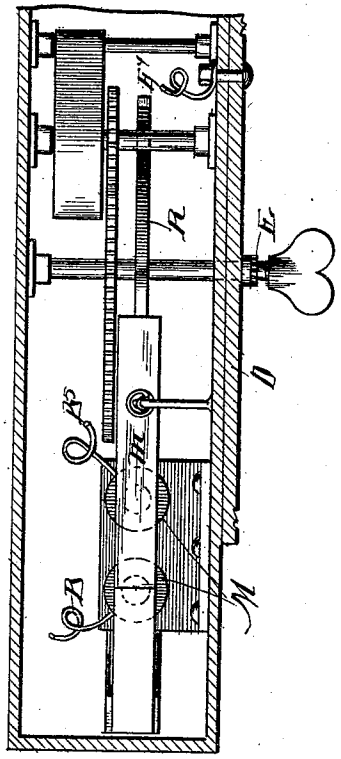


Fig. 4.

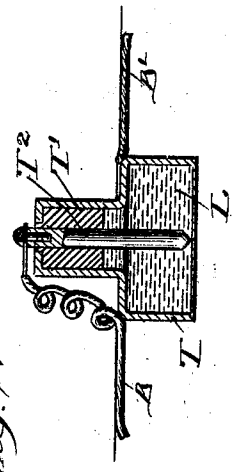
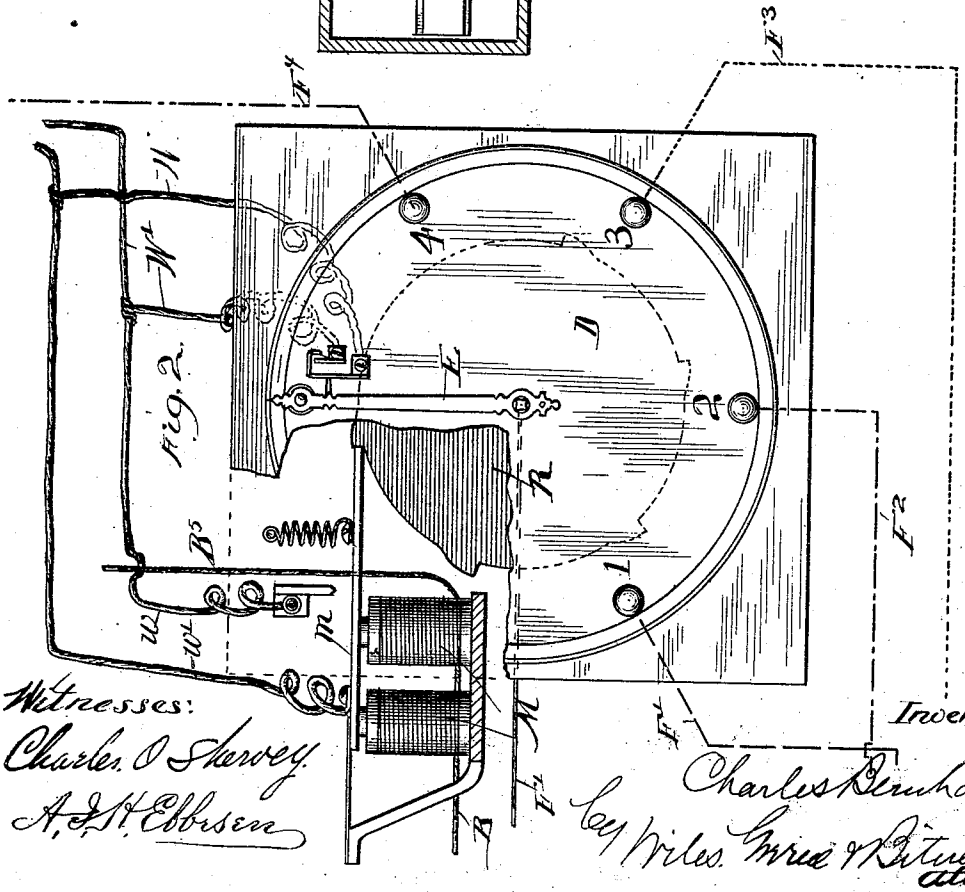


Fig. 2.



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(No Model.) 3 Sheets—Sheet 3.

C. BERNHARDT.

ELECTRIC FIRE ALARM.

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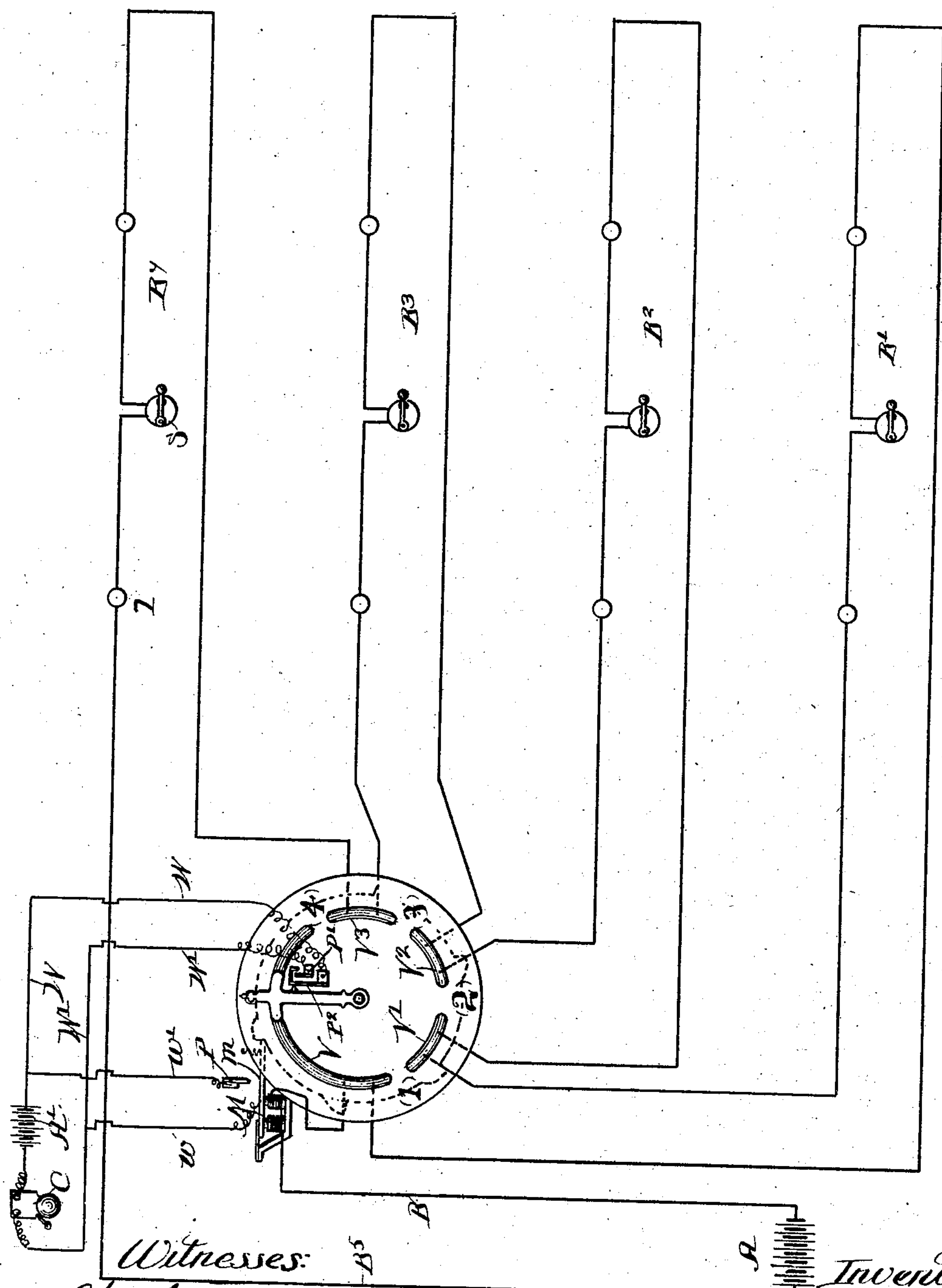

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Fig. 5.

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UNITED STATES PATENT OFFICE.

CHARLES BERNHARDT, OF CHICAGO, ILLINOIS, ASSIGNOR OF ONE-HALF TO WILLIAM H. ALTMAN, OF SAME PLACE.

ELECTRIC FIRE-ALARM.

SPECIFICATION forming part of Letters Patent No. 501,905, dated July 18, 1893.

Application filed October 3, 1892. Serial No. 447,585. (No model.)

To all whom it may concern:

Be it known that I, CHARLES BERNHARDT, a citizen of the United States of America, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Electric Fire-Alarms, of which the following is a specification.

My invention relates to improvements in electric fire alarms, its object being to produce and provide a fire alarm system consisting, in the main, in a closed electric circuit, a series of thermostats lying in said circuit and provided with contact points in contact at ordinary temperatures but adapted to separate under the influence of heat, and thereby to break the circuit, and an alarm adapted to be operated upon the breaking of the circuit.

My invention also comprehends the combination with such a circuit and alarm of an indicator adapted to show the location of the point at which the circuit is broken, together with means for operating said indicator to make it effective for the purpose to which it is designed.

The invention is fully described and explained in this specification and shown in the accompanying drawings, in which—

Figure 1 is a diagrammatic representation of a fire alarm system embodying my invention. Fig. 2 is an enlarged front elevation of the indicator of the system and certain other parts co-operating therewith. Fig. 3 is a view of said indicator and co-acting parts, partly in top plan and partly in horizontal section. Fig. 4 is a central vertical section of a preferred form or thermostat which I use as part of the system; and Fig. 5 is a diagrammatic representation of a modified form of my system.

In the views, A is a battery of ordinary construction, and B, B′, B^2, B^3, B^4, B^5, are the various parts of a continuous wire circuit joining the poles of the battery, the various letters being applied to different parts of the wire for convenience in designating them in the following description and explanation.

M is an electro-magnet lying in the circuit and provided with an armature, *m*.

T, T, T, are thermostats lying in and forming part of the circuit, and S, S, S, are switches, also lying in the circuit and provided for the purpose of enabling a watchman or other attendant to conveniently break the circuit when desired, for the purpose of turning in an alarm.

The system shown in Fig. 1, is supposed to be arranged in a building of several stories, the parts, B′, B^2, B^3, B^4, being the wires in the different stories; but so far as the invention is concerned, these various parts may lie in the same floor but in different apartments of the same building, or may be in a single apartment, as convenience may determine.

C is an alarm bell lying in a circuit made up of wires, W, W′, and including a battery, A′, independent of and separate from the battery, A, the wire, W, of this bell circuit, being connected with the armature, *m*, of the magnet, M, by means of a wire, *w*, and the wire, W′, of the circuit being connected by means of a wire, *w′*, with a contact pin, P, lying above and in range of movement of the armature, *m*, of the magnet, M. This bell is so arranged as to ring when the circuit in which it lies is closed; so it is evident that if the circuit in which the electro-magnet, M, lies be broken, the armature, *m*, will be released, and being drawn upward by the usual operating spring, will come in contact with the contact point, P, and thereby close the bell circuit through the wires, *w*, *w′*. If, therefore, the main circuit, which includes the thermostats, T, be broken at any point, either through the operation of the thermostats or by the breaking of the wire, or by the opening of the switches, S, S, S, or in any other manner, the bell must ring and an alarm be turned in at the point at which the bell is located. The thermostats through whose operation the circuit is to be broken in case of fire in their immediate vicinity, may be of any suitable construction adapted to accomplish their object, but a preferred and perfectly practicable form is illustrated in Fig. 4, in which T is the body of a closed thermostat of sheet metal, and T′ is an insulating plug closing the neck of the insulator, the body of the thermostat being filled with any suitable fluid, which may be air, or gas, or a liquid, L, adapted to expand under the operation of heat, and not liable to corrode or oth-

erwise injure the surfaces with which it comes in contact. The liquid I have used for this purpose is turpentine, which operates quickly and with perfect certainty; but I do not desire to limit my invention to the use of this liquid, or any other liquid, as I have found in practice that the expansion of air or gas is sufficient to operate the thermostat.

A spindle, T^2, preferably provided with a conical point at its free end, is inserted in the insulating plug, T', in such a way that at any normal or safe temperature the point of the spindle is in contact with the bottom of the thermostat. The ends of the wires making up the circuit in which the thermostat lies are in electric contact, respectively, with the exposed end of the spindle, T', and the body of the thermostat; and it is evident that so long as the point of the spindle is in contact with the bottom of the thermostat, the circuit must remain closed. Upon the application of sufficient heat to the thermostat, however, the fluid, L, within it expands, the sheet metal bottom is pressed away from the spindle, T^2, the contact of the spindle and the bottom is interrupted, and the circuit is broken whereupon the armature, *m*, is released, the bell circuit is closed, and the alarm is given. In close proximity to the electro-magnet, M, is a dial, D, provided with an indicating hand, E, which is connected with a spring actuated train behind the dial, adapted to rotate in the direction indicated by the arrow at the periphery of the dial in Figs. 1 and 2. Upon the shaft which carries the hand is mounted a ratchet wheel, R, formed with teeth so placed with reference to the electro-magnet as to abut against the extended end of the armature, *m*, which is thereby adapted to serve as a pawl or stop for the ratchet wheel.

In the face of the dial is a series of contact buttons, 1, 2, 3, 4, lying in the path of rotation of the hand, E, and intended to represent different floors or apartments of the building in which the fire alarm system is situated; and wires, F', F^2, F^3, F^4, appearing in variously broken lines in Figs. 1 and 2, lead from these contact buttons, respectively, to the parts of the main wire circuit in the different stories or apartments of the building, the wire from the button, 1, being carried to the end of the first floor wire, the wire from the button 2 being carried to the end of the second floor wire, and so on through the series. The arbor of the hand, E, is connected with the branch, B', of the main circuit, at a point near the corresponding pole of the battery, A, by means of a wire, F.

An examination of Fig. 1 will show that the positive pole of the battery, A, is connected with the pointer, E, by means of the short wire, F, and that the negative pole is connected with the buttons, 1, 2, 3, 4, respectively, by means of the wires F', F^2, F^3, F^4, the point at which the wire, F^4, leaves the main circuit being nearest of the series to the negative pole, the point at which the wire, F^3, leaves the main circuit being next in order, and the points at which the wires, F^2, F', leave the main circuit being successively farther and farther from the negative pole of the battery. If, now, the main circuit be broken at any point, the release of the armature, *m*, from the electro-magnet, M, must release the ratchet wheel, R, leaving it free to rotate in the direction indicated by the arrows at the margin of the dial, and to carry with it the hand, E, which, in its course, must come in contact successively with the buttons, 1, 2, 3, 4, or with so many of them as it may reach before its movement is arrested. If the break in the circuit be in the branch, B', the contact of the hand, E, with the button, 1, will close a circuit made up of the hand, the button, the wires, F, F', the wires, B^2, B^3, B^4, B^5, B, the battery, A, and the magnet, M. As soon as the circuit is closed, the armature, *m*, will be drawn into contact with the cores of the magnet, and the end of the extended armature will form a stop to arrest the rotation of the ratchet wheel, R, and hand, E. As soon, therefore, as the hand reaches the button, 1, it will instantaneously and automatically close a circuit which must arrest the movement of the ratchet wheel and hand upon the button, 1, thereby indicating the position of the break in the circuit. If, however, the break in the circuit be in some other branch, as, for instance, in the branch, B^3, the contact of the hand, E, with either of the buttons, 1 and 2, will not close a circuit passing through the magnet, M, and the hand will therefore continue to move until it reaches the button, 3, when a circuit will be closed through the hand, the button 3, the wires, F, F^3, the wires, B^4, B^5, B, the battery and the magnet; and the armature will again be drawn into a position to arrest the rotation of the ratchet wheel. Through this operation of the hand and its co-acting parts, the dial indicates the location of the break in the circuit, no matter what the cause of the break may be.

Upon the face of the dial are two contact points, P', P^2, which are the terminals of the wires W, W', respectively, of the bell circuit. The point, P^2, is of spring metal, and is so arranged with reference to the hand, E, that when the hand is in its normal position, as shown in Figs. 1 and 2, the point, P^2, is forced out of contact with the point, P', and the bell circuit is thereby broken. As soon as the breaking of the main circuit, in the manner hereinbefore set forth, permits the rotation of the ratchet wheel and the hand, E, the contact point, P^2, springs back into contact with the point, P', and closes the bell circuit, so that the bell continues to ring independently of the making or breaking of the bell circuit through the wires, *w*, *w'*, and armature, *m*, in the manner hereinbefore described. This closing of the bell circuit through the contact pins, P', P^2, is a material advantage, since it causes a continuance of

the ringing of the bell until the hand has been returned to its normal position and the contact points, P′, P², have thereby been forced apart. Were it not for this provision or some equivalent arrangement, the bell would only ring during such time as the armature, *m*, was in contact with the point, P; that is to say, during the period of rotation of the ratchet wheel, R, and hand, E; and as soon, therefore, as the hand reached the proper button for indicating the location of the break in the circuit, the bell would cease to ring. By means of the combination of the two devices for closing the bell circuit, the ringing of the bell, from the moment the main circuit breaks until a proper alarm is given, is provided for with absolute certainty. As soon as the main circuit breaks and the magnet, M, is energized, the bell must begin to ring on account of the closing of the bell circuit through the wires, *w*, *w*′. If the indicating mechanism is in working order, and the rotation of the hand brings the armature, *m*, back to the magnet, and thus breaks the bell circuit formed by the wires, *w*, *w*′, the release of the point, P², from the pressure of the hand will close a circuit through the points, P′, P², and thus insure the continued ringing of the bell; whereas, if the indicating device be out of order and the hand does not move, the circuit through the wires, *w*, *w*′, will be maintained, and the continued ringing of the bell secured, in that manner.

In the form shown in Fig. 5, the dial, the hand, the spring-actuating mechanism for operating the hand, and the electro-magnet and armature for controlling the rotation of the hand, are the same as in the form shown in the previous figures.

The battery and the wires, B, B′, B², B³, B⁴, B⁵, all corresponding to the similarly designated parts in the form already explained, and the wires, B′, B², B³, B⁴, represent the wires in the different stories of a building provided with thermostats of the construction already described.

The dial is provided with a series of contact plates, V, V′, V², V³, taking the place of the contact button or points shown in Figs. 1 and 2, these contact plates being preferably parts of a ring separated by spaces of such width as to be completely bridged by the hand, E, of the dial when it reaches a point between any two contiguous plates. The wires B′, B², B³, B⁴, are connected with the respective contact plates by means of loops which are preferably parts of a single contiguous wire, these loops together with the wires, B, B′, B², B³, B⁴, making up a single contiguous circuit. So long as this circuit is unbroken the dial remains in its normal position and its rotation is prevented by means of the armature, *m*, which forms a stop for the ratchet-wheel connected with the hand. If the circuit be broken at any point, however, the armature is released from its electro-magnet and the ratchet wheel and hand are allowed to rotate in the direction indicated by the arrow on the hand. This rotation continues until the hand reaches such a position as to bridge over the break and again close the circuit when the armature is drawn down and the ratchet-wheel and hand arrested; and the position of the hand when thus arrested indicates the location of the break. Thus, for instance, if the break be in the wire, B′, the hand will move until it reaches the position indicated in dotted lines in Fig. 5, when it will bridge over the space between the plates, B, B′, and will take the place in the system of the wire, B′. The circuit will then be complete without the wire, B′, its course from the battery to the wire, B², being through the plate, B, the hand, E, and the plate, V′. In the same way if the break be in the wire, B², the hand will move until it bridges the space between the plates, V′, V², when the circuit will be closed, leaving out the wire, B², and the motion of the hand will be arrested. Suitably indicated numbers, 1, 2, 3, 4, are placed opposite the spaces between the plates and indicate the location in each case of the break in the wire. The operation of this system is the same as that of the other form hereinbefore described, but it has the advantage of having all its parts in a single contiguous circuit, whereas in the form shown in Figs. 1 to 4, the connecting wires, F′, F, &c., are not necessary parts of the circuit and may be broken accidentally or otherwise without giving any indication of the fact.

It is evident that a fire alarm system such as is shown in the drawings and hereinbefore explained, is constantly self testing; that is to say, any defect in any part of the circuit, either through the breaking of the wire, the breaking of a thermostat, or the imperfect contact of the point of the spindle with the base of the thermostat, must at once turn in an alarm and thus give notice of the defect. This being the case, any imperfection in the system must be immediately discovered, and every part of the system must therefore be kept constantly in working order and afford absolute certainty of notice of any increase of temperature sufficient to separate the contact points in any one of the thermostats. It is, therefore, impossible that the system shall fall into such disrepair as not to be available at all times for the purpose to which it is designed.

As shown in the drawings and above described, the only devices to be operated by the circuit and the parts connected with it are a suitably situated alarm bell and an indicator for showing the exact location of the point in the circuit at which it is broken. It is common, however, to combine with a fire alarm circuit or with an electric circuit used for some other purpose, a register adapted to be operated thereby; and such a register may evidently be used in combination with the fire alarm circuit shown and described, such register being either substituted for the bell

or the indicator, or used in addition to one or both of them.

As such registers are common and well known, and form no part of this invention, it is not thought necessary to illustrate the combination of such a register with the system shown in the drawings.

Having now described and explained my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination with a closed electric circuit of a thermostat made up of a hollow body containing a suitable fluid and having an elastic wall of conducting material, and a conducting spindle entering the fluid and having its point normally in contact with said elastic wall but separable from it through the expansion of the fluid under the influence of heat, said spindle and elastic wall being in electrical connection with the circuit and insulated from each other, except at their normal point of contact whereby the contact of the spindle and elastic wall maintains the circuit, and their separation breaks the circuit.

2. The combination with a closed electric circuit, of a thermostat made up of a body, T, filled with a suitable liquid and having an elastic base, an insulating plug, T′, closing the thermostat and confining the liquid therein, and a conducting spindle, T^2, set in the block and having its point normally in contact with the base of the thermostat, but adapted to be separated from it through the expansion of the liquid under the influence of heat, the spindle and the body of the thermostat being in electrical connection with the wire of the circuit, whereby the contact of the spindle with the base of the thermostat maintains the circuit and the separation of the spindle from the base breaks the circuit; substantially as shown and described.

3. In a fire alarm system, the combination with a closed electric circuit, thermostats lying therein and adapted to break the circuit under the influence of heat, and an electro-magnet controlled by the circuit, of an indicating dial, a hand mounted on a rotatable shaft upon the dial and electrically connected with the closed circuit, a ratchet wheel mounted on the shaft and rotating therewith, an armature operated by the electro-magnet and serving as a movable stop for the ratchet wheel, contact points arranged upon the dial in the path of rotation of the hand, and wires connecting said contact points with different points upon the closed circuit, whereby, upon the breaking of the circuit, the armature of the electro-magnet may release the ratchet wheel and permit rotation of the hand, and the contact of the hand with the proper contact point upon the dial may close a circuit through the wire connected with said contact point and thereby operate the armature and arrest the rotation of the ratchet wheel and hand; substantially as shown and described.

4. The combination with a closed circuit made up of parts, B, B′, B^2, &c., of an electro-magnet lying in the circuit, a dial, D, a hand, E, mounted on the dial, contact points mounted on the dial and connected with various points on the circuit, the ratchet-wheel, R, rotating with the hand, E, and the armature, *m*, operated by the magnet M, and acting as a stop for the ratchet wheel, whereby, the breaking of the circuit may release the ratchet wheel and permit rotation of the hand, and the rotation of the the hand to the proper point may close the circuit and thereby actuate the armature and arrest the rotation of the ratchet wheel and hand, thereby indicating the location of the break in the circuit; substantially as shown and described.

5. In a fire alarm system, the combination with a series of wires provided with thermostats forming parts of a closed electric circuit, of a dial, a series of contact plates mounted thereon and separated by suitable spaces, a hand mounted on the dial and adapted to bridge over the spaces between said contact plates, loops joining the ends of the wires of said series and passing through said contact plates, respectively, means for rotating said hand, and an electro-magnet lying in the circuit and adapted to prevent rotation of the hand when the circuit is closed, but to permit such rotation when the circuit is broken.

6. The combination with the closed circuit, the electro-magnet, M, and its armature, *m*, the hand, E, and ratchet wheel, R, of the secondary circuit and bell lying therein, and the contact points, P′ P^2, forming terminals of the wires of the secondary circuit, one of said contact points being pressed out of contact with the other by the hand, E, so long as the hand is in its normal position, but released by the rotation of the hand upon the breaking of the closed circuit, whereby, upon the breaking of the closed circuit, the bell in the secondary circuit may be rung; substantially as shown and described.

7. The combination with the closed circuit and the electro-magnet, M, lying therein and provided with the armature, *m*, of the dial provided with the hand and ratchet wheel, the secondary circuit made up of wires, W, W′, and the bell, C, lying therein, the contact points, P′, P^2, forming terminals of the wires, W, W′, and held out of contact by the hand, E, while the hand is in its normal position, the contact point, P, and the wires, *w*, *w*′, connecting the wires of the secondary circuit with said contact point, P, and the armature, *m*, respectively, whereby the secondary circuit may be closed either by the release of the armature *m*, from the electro-magnet, or by the movement of the hand, E, from its normal position, and the consequent contact of the points, P′, P^2, substantially as shown and described.

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